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discovered." * The fireballs of August 11 and December 30, 1878, as well as that of February 3, 1879, had very rapid motions, and we can perhaps best account for the non-appearance of aerolites on the theory of their complete disintegration.† The meteors, it is obvious, could not have escaped out of the atmosphere. Events of this kind are doubtless of very rare occurrence. We have, it is believed, no authenticated instance in which a fireball has escaped after approaching within 39 miles of the earth's surface.‡ Assuming this as an inferior limit and taking 100 miles as the greatest height at which such bodies become visible, it is easy to show that but one in thirty-four can continue its orbital motion.

SUGGESTION TO OBSERVERS.

In the theory of meteors it is a matter of first importance to determine the form of their orbits. If any move in hyperbolas they must have had a proper motion in space before entering the solar system. Now the nature of a meteor's orbit is determined from its observed velocity. Unfortunately, however, the time of flight (on which the velocity depends) is generally a very uncertain element; the estimates of different observers being very discordant. Persons therefore who report such phenomena should train themselves to habits of exactness in measuring the time of visibility.

Stated Meeting, May 16, 1879.

Present, 28 members.

Vice-President, Mr. FRALEY, in the Chair.

A letter of envoy was received from Mr. A. Agassiz.

A letter of invitation to the members to attend the last session, May 9th, of the West Chester Philosophical Society was received.

Donations for the Library were received from the editor of the *Zoologischer Anzeiger*, Leipzig; M. Melsens, Brussels; the *Annales des Mines*, Paris; Meteorological and Antiquarian Societies, Cobden Club, and *Nature*, London;

* Met. Astr., p. 65.

† The average height of shooting stars at extinction is about 55 miles; that of aerolitic fireballs and detonating meteors at the time of explosion, about 25 miles.

‡ This was the nearest approach of the great meteor of July 20, 1860. See Prof. Coffin's memoir in the *Smithsonian Contributions*, vol. XVI.

Science Observer, Boston ; Professors Brush and Dana ; New Jersey Historical Society ; Franklin Institute, Medical News, Numismatic and Antiquarian Society, Philadelphia ; and Mr. Horace W. Smith.

The librarian exhibited the six volumes, in elephant folio, bequeathed to the Society by its late President, Dr. George B. Wood, entitled, *Gli Edifizi di Roma e sua campagna, &c. By Com. Luigi Canina*, 1848, 1851, 1856.

Vols. I and II describe the Roman walls, gates, forums, basilicas, porticos, illustrated in 151 plates ; Vols. III and IV describe the Roman theatres, amphitheatres, circuses, baths, aqueducts, bridges, and imperial Palatine houses, in 159 plates ; and Vols. V and VI describe the antiquities of the Campagna with a large detailed map of the same in six sheets, and 139 plates of views.

An obituary notice of the late Dr. Isaac Hays was read by Dr. D. G. Brinton according to appointment April 18, 1879.

The death of Prof. Paolo Volpicelli at Rome, his natal city, at 11 p. m., April 14th, 1879, was announced by family circular.

A communication "On the Geology of the Diamantiferous Region of the Province of Paraná, Brazil, by Orville A. Derby, M. S.," was read by the Secretary. This English version of a Portuguese report prepared for the Brazilian Government was read by permission of the Director of the National Museum.

Mr. Lesley remarked that the paper just read was an important contribution to Geology for several reasons:

1. It showed the topography of the southern part of Brazil in a new light. The province of São Paulo, south of the celebrated diamond province of Minas Geraes, and the province of Paraná, south of São Paulo, were traversed by three ranges of mountains, the Sierra do Mar, or Serra Graciosa, 3000 feet high, with peaks 5000 feet high, along the coast ; composed of granite, porphyries and schists, equivalent to our Blue Ridge, South Mountain and Highland range. Back of this the Serra Serrinha (or Little Mountain) over 3000 feet high, composed of highly inclined metamorphic non-crystalline schistose gneisses, red schists, and talcose or hydromica schists, probably of Cambrian and Silurian age, with a covering of pebbles of

itacolumite and other quartzites. And back of this again at the west border of the famous Campos Geraes grass plain, the Serra de Esparança, also about 8000 feet high, composed of Devonian (and carboniferous?) fossiliferous soft red sandstones resting on the shales and sandstones of the great plain, and having a bold escarpment towards the east, like our Allegheny-Cumberland backbone range. The upper part of the escarpment, however, is an outcrop of amygdaloidal and porphyritic trap 350 feet thick, and full of agates, which forms the long back or west slope perhaps all the way to the Paraná river, the border of Bolivia; and this is conjectured by Mr. Derby to be of Trias age.

2. The trend of the formations resembles that of the Atlantic border of the United States, being from west of south to east of north. But while the general geographical order is the same, namely,—Azoic, on the east along the coast, and Devonian on the west,—there are striking differences, first in its great simplicity, and secondly, in the Trias and trap lying west of the Devonian. All three ranges have escarpments towards the east. A very high (2000 feet) plateau fills in the space between the first and second ranges; and another plain sloping gently westward, and 1500 to 2000 feet above the sea, fills in the belt 100 miles wide between the second and third ranges. There is, therefore, a general uptilt of this part of Brazil towards the east; higher and higher rocks coming in as one goes west, and the whole slowly settling into the great central plain of South America, as ours do under the plain of the Mississippi Valley.

3. The drainage system has some striking features of resemblance to that of the United States when we consider the short rivers which flow eastward into the Atlantic, and the long rivers, like the Upper Ohio, Kenawha and Tennessee, which flow through the Allegheny Mountains *down dip*, westward into the Mississippi. For Mr. Derby describes four main rivers: 1. The short Ribeira which alone flows east, through the granite range, into the Atlantic; 2. The long Iguassu on the south, and 3, the long Parapamena on the north, both of which drain the first high plateau and flow in opposite directions from one another, and then turn and cut westward into the face of and through both escarpments, and through the second plain; and 4, the long Ivahy, between them, which cuts across the second plain and third escarpment westward, also into the Paraná.

4. Mr. Derby shows that the pot holes of the Tibagy (a branch of the Parapamena) got their diamonds and other crystals not *directly* from any older formation than the Devonian, for the Tibagy drains nothing but Devonian country. But again he shows that the diamonds, &c., must have been set free by the erosion of the Devonian sandstones as pebbles or sand-grains or fossils; for the Devonian sandrocks are not in the least metamorphosed. The diamonds must therefore have been originally derived from much older itacolumite rocks, &c., out of which the Devonian rocks themselves were constructed by erosion and deposition.

Dr. LeConte, at the request of Mr. Dubois of the U. S. Mint, exhibited a very fine specimen of laminated native

copper from the Calumet and Hecla mine, Lake Superior, and explained its appearance on the supposition that it had been subjected to a sliding pressure between the two walls of a fissure, thus representing a phase of slickensides.

Prof. Cope presented a paper entitled, "Notes on some landshells of the Pacific slope, by J. G. Cooper, M. D.

Mr. Lesley exhibited a slab of limestone full of Trenton trilobites, given nine years ago to Dr. Isaac Lea by Mr. S. Emlen Sharples, of Bucks County, Pennsylvania, who took it from the walls of a limekill at a quarry near Greenville, on the north edge of the belt of limestone rocks (enclosed in Mesozoic) 3000 feet thick, and dipping northward.

The slab is given by Dr. Lea to the Museum of the Geological Survey, and is valuable in evidence of the presence of the Trenton formation in a range over which discussions have been and are still taking place. It is of especial interest just now in view of the late publications of Prof. J. D. Dana, on the new localities of Trenton fossils around Poughkeepsie, east of the Hudson river.

The minutes of the last meeting of the Board of Officers were read.

Pending nominations Nos. 878 to 883, and new nomination No. 884 were read.

The Treasurer moved the following resolution, which was adopted :

Resolved, That the Treasurer be authorized to execute under the seal of the Society a transfer of the certificate of \$5000 of the U. S. six per cent. loan held by them, and called in by the Secretary of the Treasury.

Dr. LeConte's resolutions of May 2, being in order of business, it was, after debate, on motion of Mr. McKean, resolved that the consideration of the resolutions be postponed to the second regular meeting in October next.

On motion, leave was given to Mr. Briggs, and Dr. Barker, and to Mr. Britton to withdraw their reports read at the last meeting.

On motion, an appropriation of \$10 was made for subscribing to the life of Dr. William Smith, by H. W. Smith,

one volume of which was exhibited, and the other promised in August next.

The meeting was then adjourned.

The Geology of the Diamantiferous Region of the Province of Paraná, Brazil. By Orville A. Derby, M. S. (English Version.)

(Read by permission of the Director of the Brazilian Museum before the American Philosophical Society, May 16, 1879.)

A portion of the ancient Capitania of São Paulo, now the province of Paraná, has long been known to be diamantiferous, but as no extensive washings have ever been undertaken, and as the gems thus far found have been of small size, although of good quality and color, only very little attention has been attracted to this region, in comparison with the more fully explored diamond fields of the provinces of Minas Geraes and Bahia. During a recent excursion in Paraná, I was able to make some observations on the geology of the region in question, and on the mode of occurrence of the diamonds.

The province of Paraná lies between São Paulo on the north, and Santa Catharina and Rio Grande do Sul on the south, and extends from the Atlantic to the river Paraná, occupying about six degrees of longitude and three of latitude. Topographically it is divided into two very distinct regions: a mountainous region along the coast, extending about 100 miles inland, and a plateau region, occupying the central and western portions of the province. The first or mountainous region constitutes a distinct geological area, while the plateau portion is divided into two grand geological provinces. Strictly speaking, the whole province, with the exception of a coast belt from ten to twenty miles wide, is a plateau, the coast mountains, constituting a part of the great Serra do Mar system, but known in this province by the beautiful and appropriate name of the Serra Graciosa, rising abruptly from the coast belt, and forming the margin of a plateau, from 800 to 1000 metres in height. In the northeastern part of this great plateau, an interior range of mountains, a continuation of the Paranápiacaba range of São Paulo, rises above the general level, but dies away towards the south. The coast belt, the Serra do Mar, and the eastern portion of the great interior plateau, whether mountainous, as in the north, or nearly level, as in the south, have the same general geological characters, and may properly be united together in what I will designate as the first or mountainous or, geologically speaking, the metamorphic region. The topography of this region, in the more mountainous portions, is bold and abrupt, with picturesque peaks, rising to a height of about 1500 metres above the sea, and 600 to 700 metres above the river valleys and the more level portions. The latter are, in general, moderately undulating prairies,